

THE ARCTURUS OCEANOGRAPHIC EXPEDITION*

BY WILLIAM BEEBE

(Fig. 1 and Plates A. B. C.)

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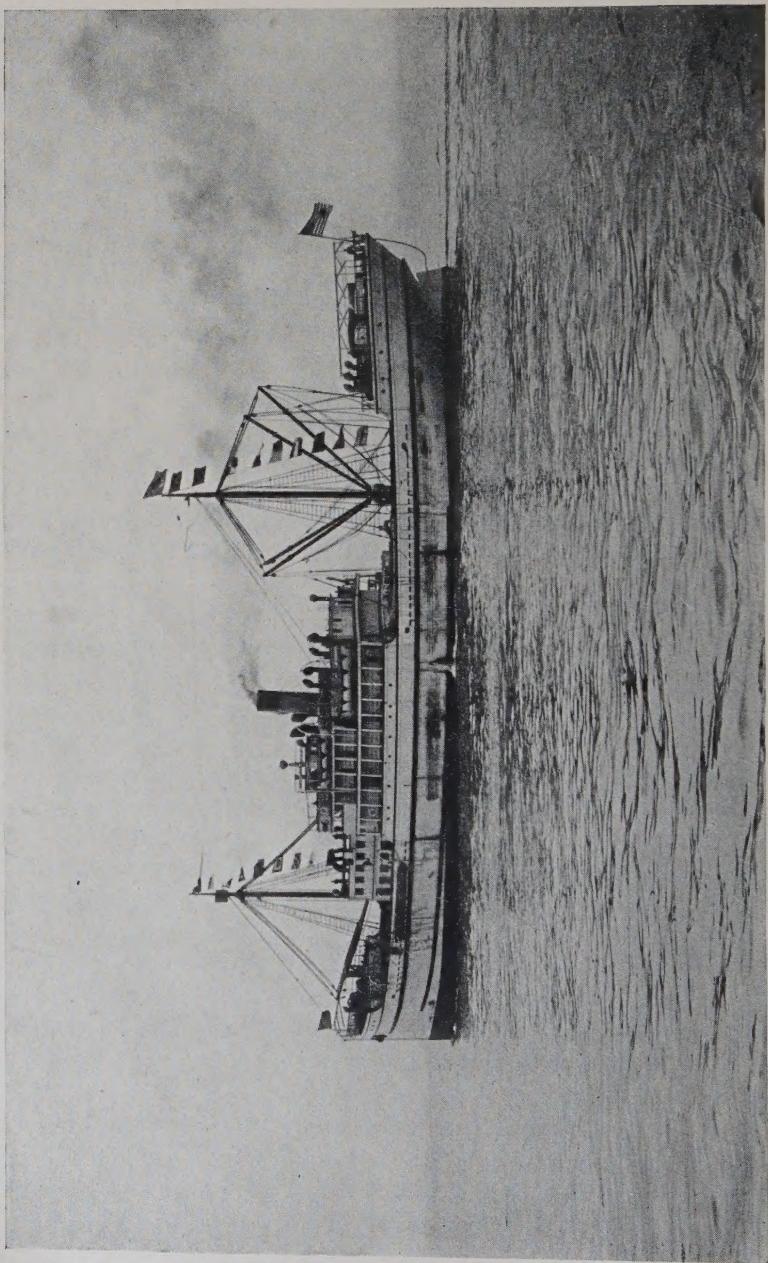
I. INTRODUCTION

The Arcturus Oceanographic Expedition, the ninth expedition of the New York Zoological Society, sailed from Brooklyn on February 11th, 1925, and returned to New York on July 30th. In the interval we steamed a distance of over 13,600 miles, touching at Norfolk, Bermuda, Panama, Cocos Island and the Galapagos. We brought back 11,000 feet of first rate motion picture film, besides a great many colored plates and photographs. We established one hundred and thirteen stations, made hundreds of hauls with nets and dredges, threw overboard two thousand drift bottles containing the usual data.

The avowed objects of the expedition were the investigation of the Sargasso Sea and the mid and deep sea life beneath it, and the study of the Humboldt Current. Owing to continual storms the former was in such a disintegrated condition that I soon decided to postpone detailed study until a more favorable time. In the Pacific, to our surprise, we found that there was absolutely no trace of the Humboldt Current about the Galápagos. The inexplicable absence of this great, cold, Antarctic current was amply compensated for by the equally unexpected presence of unusual natural events.

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Fig. 1. S. Y. Arcturus.



Among the high lights of the expedition may be mentioned the great volcanic eruption on Albemarle Island, the albatross rookery on Hood, the remarkable results of hundreds of dives in a copper helmet and bathing suit in the shark-infested waters about Cocos and the Galapagos, a current rip, temporary and on an enormous scale in mid-Pacific. The accomplishment which, scientifically, proved to be the most valuable of all, was the result of my decision to make a ten-day stay in one spot in mid-ocean, Station 74, sixty miles south of Cocos where continual dredging yielded very remarkable collections of fish and crustaceans, equivalent to any two months of the less intensive work. The crustacea alone taken at this place equalled eighty percent of all the rest which we took in the Pacific.

Accurate accounts in popular language have already been brought out by me in "The *Arcturus Adventure*" published under the auspices of the Zoological Society by G. P. Putnam's Sons, New York City, a companion volume to "Galapagos: World's end."

The origin and evolution of life, men and expeditions are interesting. On the very day of my return from the Galapagos in the *Noma*, I was introduced to a recently elected member of the Board of Managers of the Zoological Society, Henry D. Whiton. Mr. Whiton said to me, "You seem tremendously interested in the Galapagos; if you ever want to go back there I will furnish the steamer if you can get someone else to provide the coal." So from this generous, tentative beginning there crystallized the twenty-four hundred ton steam yacht *Arcturus*, the specified coal, a splendid oceanographic outfit, a captain and a crew, and an expedition of six months' duration, which steamed from New York to the Sargasso Sea, thence to Cocos and the Galapagos, and which secured a host of treasures, from the most microscopic beings which contribute to the surface luminescence of the sea, to a giant devilfish weighing more than a ton.

The two chief contributors to the expedition were Henry D. Whiton, who gave the *Arcturus*, and Harrison Williams who provided three-fourths of the entire cost. Other generous contributors were Marshall Field, Clarence Dillon, Vincent Astor, The American Museum, George F. Baker, Jr., Arthur T. Newbold, Thomas S. Yates and Junius S. Morgan. Other gifts to be recorded are a sounding machine from William H. Trotter; Sets of Oceanographic books from Frederic C. Wolcott; motion picture negatives from George Eastman; Flashlights and batteries from the National

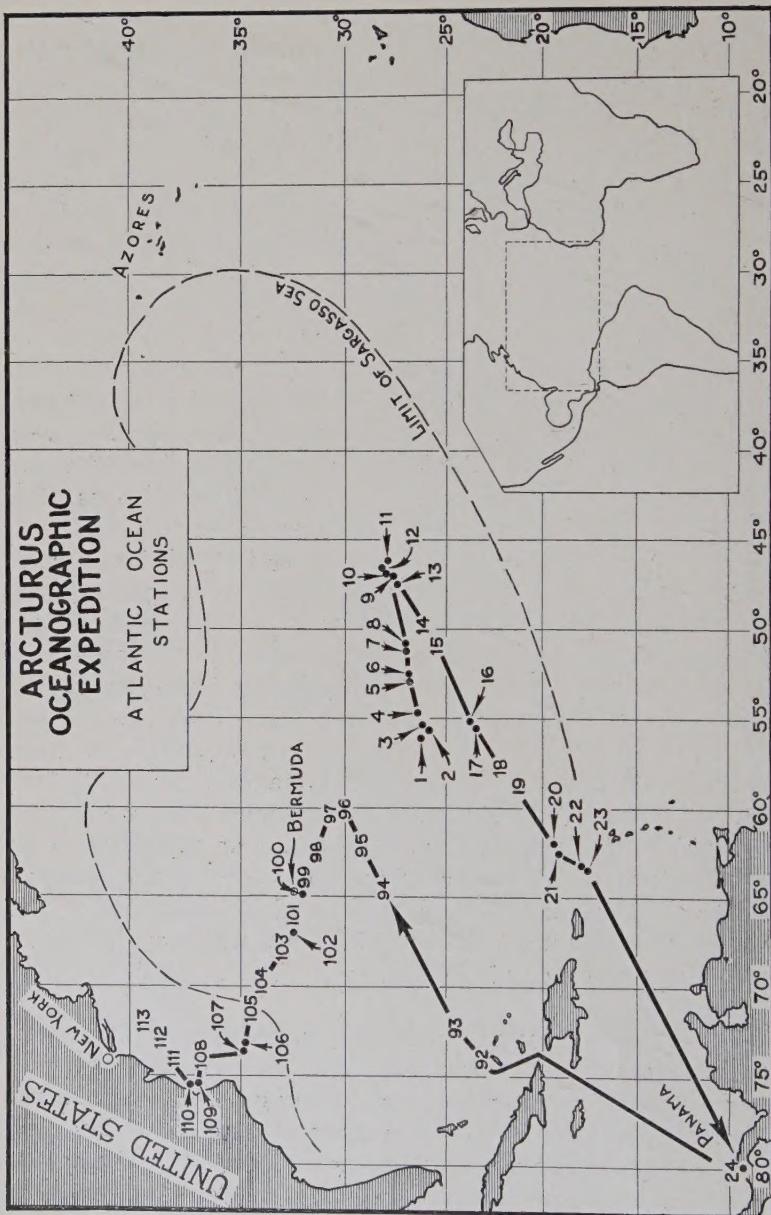


Plate A. Atlantic Ocean Stations. Arcturus Oceanographic Expedition.
From a drawing by John Tee-Van.

Carbon Co.; a powerful radio set from the Stromberg-Carlson Mfg. Co. and the launch *Pawnee* from Harry Payne Bingham. To Earnest Lester Jones, Chief of the Coast and Geodetic Survey, I am obliged for a host of kindnesses and the loan of valuable instruments, and to the U. S. Fisheries Bureau for the *Albatross* launch and much valuable gear.

The entire responsibility for the sea-going condition of the *Arcturus*, her complete overhauling and the supervision of the building of laboratories, dark-rooms, refrigerators, and oceanographic apparatus was assumed by Mr. J. R. Gordon and the naval architect, Edwin C. Bennett. Capt. Yates acted throughout for Mr. Williams, and it is to the whole-hearted enthusiasm and interest of these gentlemen that the smoothness of operation and general success of the mechanical basis of the expedition was due.

For Captain Howes and First Mate McLaughlin I have nothing but single-minded praise. No more willing, patient and capable seamen ever existed.

The scientific staff was of my own choosing, each of the seventeen members having a definite field of work, which they filled to the full extent of their ability. Without their loyalty, constant enthusiasm and coöperation, nothing of success could have been achieved.

The scientific working personnel was as follows: William Beebe, Director; W. K. Gregory, Associate in Vertebrates; L. Segal, Associate in Special Problems; C. J. Fish, Associate in Diatoms and Crustacea; John Tee-Van, General Assistant; William H. Merriam, Assistant in Field Work; Isabel Cooper and Helen Tee-van, Scientific artists; Ruth Rose, Historian and Technicist; Marie Fish, Assistant in Larval Fish; Elizabeth Trotter, Assistant in Fish Problems; Dwight Franklin, Assistant in Fish Preparation; Jay F. W. Pierson, Assistant in Macroplankton; Don Dickerman, Assistant artist; E. B. Schoedsack, Assistant in Photography; Serge Chetyrkin, Preparateur; D. W. Cady, Surgeon.

II. LIST OF STATIONS WITH ACCOMPANYING DATA

The abbreviations used in the individual hauls are as follows:

T—Tow net
PT—Petersen trawl

OT—Otter trawl
BT—Blake trawl

Station Number	Individual Haul	Position		General Locality	Nearest Soundings Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres	D—Dredge	RSD—Rope scallop dredge
		Lat. North	Long. West									
1	T ₁	26° 10'	56° 07'	580 m SE of Bermuda		Feb. 23	8.45 A.M. 9.16 A.M.	1.15	0	0	0	0
	PT ₁						12.30 P.M.	1	0	0		
	T ₂						1.40 P.M.	1	0	0		
	T ₃						1.40 P.M.	1	0	0		
	PT ₃						2.40 P.M.	1	0	0		
2	T ₄			{ 630 m. SE of Bermuda 625 m. NE of Sombroek		Feb. 23	3.28 P.M.	273-0	273-0	500-0	0	0
	V ₁						8.00 P.M.	2	0	0		
	T ₅	25° 56'	55° 42'				8.00 P.M.	2	0	0		
	T ₁						4.00 A.M.	1	0	0		
3	T ₂					Feb. 24	4.00 A.M.	1	0	0	0	0
	T ₃						6.00 P.M.	1	45	0		
	T ₁	26° 19'	54° 53'				5.00 P.M.	30	278-0	310-0		
4	V ₁			650 m. SE of Bermuda	4000	Feb. 24	6.30 P.M.	1	0	0	0	0
	T ₁						6.30 P.M.	1				
	T ₂						6.30 P.M.	1				
5	V ₁	26° 42'	52° 59'	745 m. SE of Bermuda	3000	Feb. 25	1.56 P.M.	44	195-0	357-0	200	75
	T ₁						3.03 P.M.	1	109	41.8		
	T ₂						3.24 P.M.	1	41	76.6		
6	PT ₁			720 m. SE of Bermuda	Feb. 25	7.50 P.M.	1	40	0	0	30	0
	T ₁	26° 43'	52° 46'				7.40 P.M.	1				
	PT ₁						10.51 A.M.	640	3000	3000		
7	PT ₁	26° 54'	51° 15'	815 m. SE of Bermuda	3000	Feb. 26	8.30 P.M.	1	0	0	0	0
	T ₁	26° 58'	50° 52'				8.30 P.M.	1				
8	T ₂											

Station Number	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Duration of Haul	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
9	T1	27° 42'	46° 59'	1040 m. ESE of Bermuda	2329	Feb. 28	8.35 A.M.	30	0	0
	V1						2.47 P.M.	24	66-0	122-0
	T2						4.28 P.M.	53	273	500
	T3								546	1000
	T4								1093	2000
	T5								1367	2500
10	T1	27° 58'	46° 54'	1040 m. ESE of Bermuda	Mar. 1	8.50 A.M.	2	10	0	0
	T2						8.50 A.M.	10	0	0
	T3						8.00 P.M.	1	0	0
	T4						8.00 P.M.	1	0	0
	D1	27° 53'	46° 24'				12.11 P.M.	4	2491	4557
	T1						7.30 P.M.	1	30	0
11	T2			{ 1070 m. ESE of Bermuda 1070 m. SW of Azores 1115 m. NE of Sombro	Mar. 2	7.30 P.M.	1	30	0	0
	T3						7.30 P.M.	1	30	0
	V1	27° 58'	46° 52'				7.30 P.M.	1	30	0
	V2								0	0
	VC1								0	0
	VC2								0	0
12	VC3			1020 m. ESE of Bermuda	Mar. 3	8.59 A.M.	109-0	200-0	200-0	200-0
	T1	27° 44'	47° 10'				9.22 A.M.	15	273	500
	T2								37	546-273
	T3								14	1093-546
	V1								57	1640-1093
	V2									3000-2000
13	T1	27° 44'	47° 10'	1030 m. ESE of Bermuda	Mar. 3	7.30 P.M.	1	20	0	0
	T2						7.30 P.M.	1	20	0
	T3								0	0
	T1	26° 10'	50° 00'						0	0
	T2								0	0
	T3								0	0
14	P1	12 noon	51° 00'	830 m. NE of Sombro	2790	Mar. 5	10.20 A.M.	3	500	909
	P2	{ 25° 29'					10.20 A.M.	15	250	450
	P3						6.43 P.M.	12	250	450
	T1						6.45 P.M.	15	0	0
	T2						6.45 P.M.	0	0	0
	T3						6.45 P.M.	15	0	0
15	P1	23° 42'	55° 09'	570 m. NE of Sombro	Mar. 7	9.30 A.M.	4	250	450	450
	T1	23° 25'	55° 31'						0	0
	T2								0	0
	T3								0	0
	T1	22° 13'	57° 44'						0	0
	T2								0	0

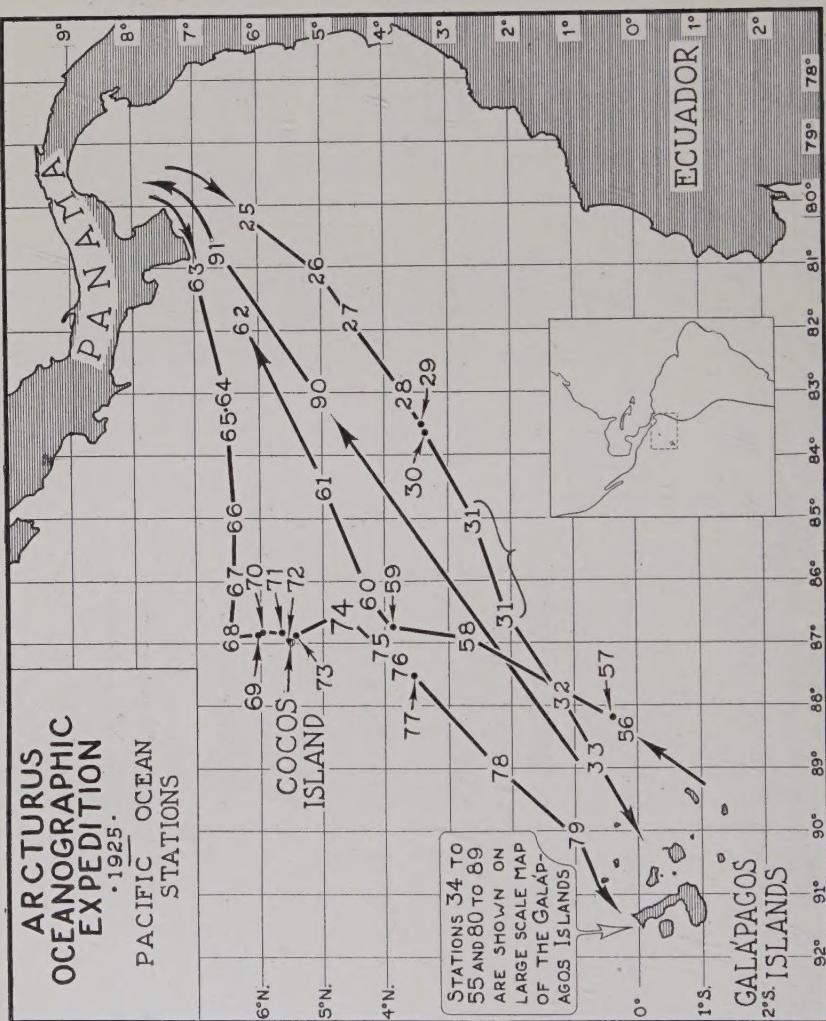


Plate B. Pacific Ocean Stations. Arcturus Oceanographic Expedition.
From a drawing by John Tee-Van.

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing Fathoms	Date 1925	Time	Duration of H. Haul M.	Depth in Fathoms	Depth in Metres
		Lati. North	Long. West					H		
19	OT1 PT1 T1	21° 10'	58° 46'	320 m. NE of Sombbrero	3146	Mar. 9	10.00 A.M. 2.30 P.M. 7.00 P.M.	4 2 2	250 250 0	450 450
20	V1 T1 T2 T3	19° 21' 10° 07'	61° 57' 62° 31'	100 m. NE of Sombbrero 65 m. NE of Sombbrero		Mar. 12 Mar. 12	2.52 P.M. 8.00 P.M. 8.00 P.M. 8.00 P.M.	1 1 1 1	8 0 0 0	200-0 0 0 0
22	Dip Nets	17° 56'	63° 12'	8 m. S of St. Martin	200	Mar. 13	7.00 P.M.			
23	OT1 OT2 RSD1 RSD2	17° 39'	63° 17'	2 m. SW of Saba		Mar. 14	8.30 A.M. 10.00 A.M. 1.30 P.M. 3.00 P.M.	15 1 1 10	45 30 120 120	82 50 218 218
23a	RSD1 RSD2 BT1 BT2 BT3	17° 39'	63° 16'	2 m. SW of Saba		Mar. 15	1.27 P.M. 2.05 P.M. 3.04 P.M. 3.40 P.M. 4.12 P.M.	7 10 10 9 10	7 54.6 54.6 70 71	12.7 100 127 130
23b	RSD1 RSD2 (tangle)	17° 39'	63° 16'	2 m. SW of Saba	478	Mar. 15	9.15 A.M. 10.58 A.M.	10 29	656 820	1200 1500
24	dip nets	9° 22.5'	79° 56'	Colon, Panama		Mar. 21-27				
25	T1 T2 T3	6° 10'	80° 11'	65 m. S of Cape Malo		Mar. 29	7.00 P.M. 7.00 P.M.	1 1	0 0	0 0
26	PT1	5° 03'	81° 18'	120 m. S of Mariato Point	2070	Mar. 30	9.13 A.M. 7.30 A.M. 9.50 A.M. 9.50 A.M. 9.13 A.M. 9.20 A.M.	1 1 1 1 1 1	0 273 20 20 136 40	0 500 0 0 250 35
27	T1	4° 30'	81° 49'	165 m. SW of Mariato Point		Mar. 30	7.00 P.M.	20	0	0
28	T1 T2			260 m. SE of Cocos	1805	Mar. 31	5.15 A.M. 5.15 A.M.	15 15	0 0	0 0

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Duration of H. Haul M.	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
29	T ₃ OT ₁ T ₁ PT ₁ PT ₁	3° 23'	83° 33'	240 m. SE of Cocos		Mar. 31	8.55 A.M. 9.15 A.M.	1 15	0 273	0 500
30	T ₁ T ₂	3° 23'	83° 34'			Mar. 31	3.50 P.M. 3.50 P.M.	30 30	136 273	250 500
31	PT ₁ PT ₂ PT ₃ PT ₄ T ₁ OT ₁	2° 36'	85° 01'	215 m. SSE of Cocos	1826	Apr. 1	8.45 A.M. 9.15 A.M.	15 20	0 13.6	0 25
		2° 8'	86° 17'				9.00 A.M. 11.00 A.M. 4.00 P.M.	1 2 2	0 273 136	0 500 250
32	T ₁ T ₂	1° 14'	87° 50'	140 m. N.E of Tower	1462	Apr. 3	5.40 A.M. 5.40 A.M.	20 20	0 0	0 0
33	PT ₁ T ₂ T ₃	0° 40'	88° 51'				2.00 P.M. 2.27 P.M. 8.00 P.M.	1 1 1	25 700 25	0 1274 0
34	T ₁ T ₂	0° 00'	90° 00'	20 m. South of Tower 22 m. NE of Indefatigable	559	Apr. 4	5.30 A.M. 5.30 A.M.	30 30	0 0	0 0
35							710			
36	T ₁ T ₂	0° 27'	90° 19'	1 m. W of Seymour	Apr. 4-6	9.30 A.M. 4.00 P.M.	30 30	0 0	0 0	
37	T ₁ T ₂ T ₃ T ₄ T ₅ T ₆ T ₇ T ₈ T ₉	0° 19'	89° 57'	Darwin Bay, Tower	Apr. 7 " 8 " 9 " 10 " 10 " 10 " 17 " 18 " 19	7.30 P.M. 7.30 P.M. 11.00 A.M. 7.30 P.M. 7.30 P.M. 7.30 P.M. 7.30 P.M. 7.30 P.M.	30 30 30 20 30 30 30 30	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing Fathoms	Date 1926	Time	Duration of Haul M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
38	PT1 PT2 T1 T2	0° 17'	90° 02'	7 m. W of Tower	448	Apr. 11	12.13 P.M. 3.23 P.M. 6.45 P.M. 6.45 P.M.	1	300 500 0 0	545 909 0 0
39	T1 T2 T3 PT1 T4 T5 T6 PT2	0° 05'	91° 11.5'	1 m. off NE coast of Al-bemarle	1039	Apr. 12	7.30 P.M. 7.30 P.M. 8.10 P.M. 10.48 A.M. 10.48 A.M. 7.15 A.M. 7.15 A.M.	30 30 30 16 16 30 30	0 0 0 500 500 0 0	0 0 0 909 450 0 0
40	T1 D1	0° 14'	91° 18'	5 m. N of Albemarle	1647	Apr. 14	4.20 A.M. 11.11 A.M.	1	30 57	0 600
41	T1 T2 T3	0° 31'	91° 00'	13 m. W of Abingdon	1409	Apr. 14	6.45 P.M. 6.45 P.M. 7.55 P.M.	30 30 10	0 0 0	0 0 0
42	T1 T2	0° 32'	91° 06'	20 m. W of Abingdon.		Apr. 15	4.50 A.M. 4.50 A.M.	25	0	0
43	D1 PT1	0° 34'	90° 47'	½ m. W of Abingdon	431	Apr. 15	10.48 A.M.	32	225	
44	PT1	0° 27'	90° 42'	Midway between Ab-ingdon & Bindloe	548	Apr. 15	3.10 P.M.	50	250	450
45	OT1 T1 T2 T3	0° 20'	90° 10'	12 m. W of Tower	493	Apr. 15	9.35 P.M. 9.30 P.M. 9.35 P.M.	33 30 30	205 0 0	372 0 0
46				Darwin Bay, Tower						
47	T1	0° 03'	89° 50'	23 m. S of Tower		Apr. 20	9.30 P.M.	20	0	0
48	PT1 T1 T2 T3	1° 20' (S)	.89° 33'	12 m. E of Hood	174	Apr. 21	4.18 P.M. 4.10 P.M. 4.18 P.M. 4.30 P.M.	27 25 27 15	50 50 50 0	90 90 90 0
49	PT1			10 m. SE of Hood	401	Apr. 21	7.40 P.M.	55	200	363

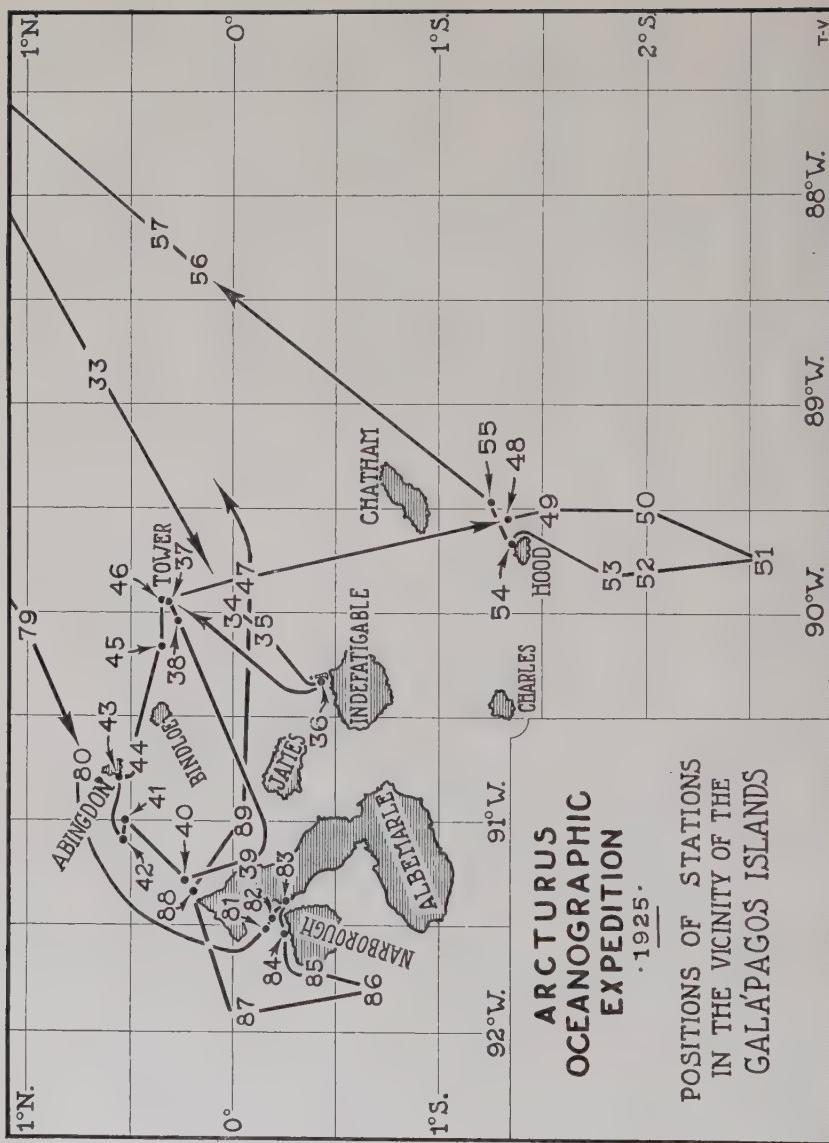


Plate C. Galapagos Islands' Stations. Arcturus Oceanographic Expedition.

From a drawing by John Tee-Van.

Station Number	Individual Haul	Position		General Locality	Nearest Soundings in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
50	T1 T2	2° 00' (S)	89° 30'	34 m. SE of Hood	1820	Apr. 22	7.40 P.M. 8.10 P.M.	.55 20	200 0	363 0
	T3						12.40 P.M. 12.40 P.M. 12.40 P.M. 12.40 P.M. 12.40 P.M.	1 1 1 1 1	35 35 35 35 35	0 400 800 800 1200
	OT1									727 1454 1454
	T4									2181
	PT1									2181
	T5									0
51	PT1	2° 33' (S)	89° 44'	67 m. S of Hood	1835	Apr. 23	9.00 A.M. 9.00 A.M. 9.00 A.M. 9.00 A.M. 2.30 P.M.	2 2 2 2 40	273 54 273 500 800	500 100 300 500 1454
	T1									2 7 5
	T2									
	T3									
	PT2									
	T4									
52	T1	2° 00' (S)	89° 48'	34 m. S of Hood		Apr. 23	6.30 P.M. 7.30 P.M. 7.30 P.M. 9.00 P.M.	30 30 30 30	0 0 0 0	0 0 0 0
	T2									
	T3									
	T4									
53	D1	1° 51' (S)	89° 50'	25 m. S of Hood	1733	Apr. 24 Apr. 25	9.40 A.M. 9.40 A.M. 9.40 A.M. 7.00 A.M.	35 35 35 1	1733 1093 800 1733	3156 2000 1463 3156
	T1									
	T2									
	T3									
	D2									
54	T1	1° 22' (S)	89° 39'	Gardner Bay, Hood		Apr. 25 Apr. 26 Apr. 27	7.20 P.M. 7.30 P.M. 7.30 P.M.	25 25 20	0 0 0	0 0 0
	T2									
	T3									
55	T1	1° 16' (S)	89° 28'	13 m NE of Hood		Apr. 28	8.00 P.M.	20	0	0
56	T1	0° 10'	88° 22'	98 m. E of Tower	1388	Apr. 29	3.04 P.M. 3.04 P.M. 3.04 P.M.	44 44 44	400 800 800	727 1463 1463
57	T1 T2	0° 22'	88° 11'	105 m. E of Tower		Apr. 29	8.00 P.M. 8.00 P.M.	30 30	0 0	0 0
58	T1 T2	2° 42'	86° 56'	170 m. S of Cocos		Apr. 30	8.00 P.M. 8.00 P.M.	30 30	0 0	0 0

Station-Number	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Duration Haul M	Depth in Fathoms	Depth Metres
		Lat. North	Long. West							
59	T1	3° 52'	86° 43'	105 m. S of Cocos	796	May 1	5.15 A.M.	30	0	0
	T2						9.20 A.M.	1	45	181
	T3						9.20 A.M.	1	45	545
	T4						9.20 A.M.	1	45	909
	T5						9.20 A.M.	1	45	1090
	PT1						9.20 A.M.	1	45	1090
	T6						9.40 A.M.	1	20	0
	T7						2.15 P.M.	1	15	272
	T8						2.15 P.M.	1	15	545
	T9						2.15 P.M.	1	15	909
60	T10			90 m. SSE of Cocos 150 m. ESE of Cocos	1690.7	May 2	2.10 P.M.	50	0	0
	PT2						1.50 P.M.	1	40	272
	T1	4° 56'	84° 35'				1.50 P.M.	1	40	545
	T2						1.50 P.M.	1	40	909
	T3						1.50 P.M.	1	40	1090
	T4						1.50 P.M.	1	40	1090
	T5						1.50 P.M.	1	40	1090
	PT1						1.50 P.M.	1	40	1090
	T1	6° 16'	80° 48'	60 m. SW of Mariato Point	1036	May 3	8.00 P.M.	30	0	0
	T2	6° 58'	81° 08'				8.00 P.M.	30	0	0
	OT1						8.00 P.M.	30	0	0
	T1	6° 34'	83° 00'				8.00 P.M.	30	0	0
	T2	6° 30'	83° 33'				8.00 P.M.	30	0	0
	OT1						9.00 P.M.	30	0	0
	T3						9.00 P.M.	30	0	0
	T4						9.00 P.M.	30	0	0
	T1	6° 24'	85° 00'				10.10 P.M.	3	300	545
	T2						10.10 P.M.	3	500	909
	T3						10.10 P.M.	3	600	1090
	PT1						10.10 P.M.	3	600	1090
66	T1	6° 24'	86° 00'	130 m. NE of Cocos	1125	May 13	8.05 P.M.	30	0	0
	T2						5.00 A.M.	30	300	545
67	T1	6° 24'	86° 00'	78 m. NE of Cocos	1676	May 14	5.00 A.M.	30	300	545
	T1	6° 24'	86° 54'							

Station Number	Individual Haul	Position		General Locality	Nearest Soundings in Fathoms	Date 1925	Time	Duration of Haul H.M.	Depth in Fathoms	Depth in Metres	
		Lat. North	Long. West								
85	T1	0° 25'	91° 42'	3 m. W of Narborough		June 11	8.00 P.M.	1	0	0	
86	T1 T2 T3 T4 T5 PT1 T6 T7 T8 T9 T10 T11 OT1	0° 42' 91° 47'	16 m. SW of Narborough	1900	June 12	9.39 A.M. 9.39 A.M. 9.39 A.M. 9.39 A.M. 9.39 A.M. 2.15 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M.	51 51 51 51 51 15 18 18 18 18 18 18 18	400 500 600 800 1000 400 500 600 800 1000 1000 1000 1000	727 909 1090 1454 1818 0 727 909 1090 1454 1818 1818 1818		
87	T1 T2 T3 T4 T5 T6 PT1	0° 00'	91° 53'	21 m. NW of Narborough	1720	June 13	9.11 A.M. 9.11 A.M. 9.11 A.M. 9.11 A.M. 9.11 A.M. 9.11 A.M. 9.11 A.M.	1 1 1 1 1 1 1	49 49 49 49 49 49 49	100 400 450 500 600 700 700	181 727 818 909 1090 1274 1274
88	T1 T2 T3 T4	0° 11'	91° 21'	3 m. N of Albemarle		June 13	8.10 P.M. 9.00 P.M. 9.35 P.M. 9.45 P.M.	40 30 5 5	0 0 0 0	0 0 0 0	
89	T1	0° 02'	91° 01'	13 m. E of Albemarle		June 14	8.00 P.M.	1	0	0	
90	T1 T2	5° 04'	83° 04'	125 m. SE of Cocos		June 15	8.00 P.M. 8.00 P.M.	30 30	0 0	0 0	
91	T1 T2	6° 40'	80° 49'	25 m. S of Mariato Point		June 19	8.00 P.M. 8.00 P.M.	30 30	0 0	0 0	
92	T1 T2	22° 59'	74° 17'	Atlantic Ocean		July 3	8.00 P.M. 8.00 P.M.	30 30	0 0	0 0	
93	T1 T2 T3	24° 31'	72° 24'	60 m. S of San Salvador 120 m. E of San Salvador		July 4	8.00 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	0 0 0	0 0 0	

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Duration of Haul M	Depth in Fathoms	Depth in Metres	
		Lat. North	Long. West								
94	T1 T2 T3	28° 10'	64° 35'	250 m. S of Bermuda		July 9	8.00 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	0 0 0	0 0 0	
95	T1 T2 T3	29° 13'	62° 00'	270 m. SE of Bermuda		July 10	8.00 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	0 6 ft. 0	0 0 0	
96	T1 T2 T3	30° 00'	60° 00'	280 m. SE of Bermuda	2875	July 11	8.00 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	0 0 0	0 0 0	
	V1 V2 T4 T5 T6 T7 T8 PT1	30° 01'	60° 03'			July 12	10.36 A.M. 10.36 A.M. 10.36 A.M. 10.36 A.M. 10.36 A.M. 10.36 A.M. 10.36 A.M. 10.36 A.M.	2 2 2 2 2 2 2 2	28 28 28 28 28 28 28 28	1036-0 150 300 500 600 1200 1200 2181	1000-0 2000-0 272 545 909 1090 2181 2181
97	V1 V2 VC1 VC2 VC3 VC4 VC5 T1 T2 T3	30° 49'	61° 21'	190 m. SE of Bermuda		July 13	8.56 A.M. 10.11 A.M. 11.20 A.M.	24 24 24	820-0 546-0 273-164	1500-0 1000-0 500-300	
	VC1 VC2 VC3 VC4 VC5 T1 T2 T3	31° 22'	62° 35'	125 m. SE of Bermuda	2587		2.20 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	478-324 546-437 820-546	893-593 1000-800 1500-1000	
98	VC1 V1 VC2 V2 V3 V4 V5					July 14	10.44 A.M. 11.44 A.M. 12.52 P.M.	51 11 1093-820	820-546 164-0 273-0	1500-1000 300-0 2000-1500	
99		31° 57'	64° 00'	45 m. SE of Bermuda		•July 15	3.30 P.M. 4.40 P.M.	273-0 437-0	500-0 800-0	546-0 1000-0	
100	T1 T2 T3	32° 00'	65° 00'	10 m. S of Bermuda		July 15	8.00 P.M. 8.00 P.M. 8.00 P.M.	30 30 30	0 0 0	0 0 0	

Station Number	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Duration of Haul M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
T4						July 16	8.45 P.M.	1 45	0	0
D1							8.35 A.M.	6	29	54
D2							9.28 A.M.	12	29	53
T5							11.49 A.M.	2	13	300
T6							11.49 A.M.	2	13	300
T7							11.49 A.M.	2	13	300
T8							11.49 A.M.	2	13	300
P1							11.49 A.M.	2	13	300
T9							8.00 P.M.	30	0.	0
T10							8.00 P.M.	1	200	363
T11							8.02 P.M.	1	1	300
T12							8.02 P.M.	1	1	300
T13							10.07 A.M.	3	1	0
T14							10.07 A.M.	3	1	0
T15							10.07 A.M.	3	1	0
T16							10.07 A.M.	3	1	0
T17							10.07 A.M.	3	1	0
T18							10.07 A.M.	3	1	0
T19							10.07 A.M.	3	1	0
T20							10.07 A.M.	3	1	0
101		32° 26'	66° 23'	75 m. W of Bermuda		July 18	8.00 P.M.	30	0	0
102	T1	32° 48'	67° 09'	120 m. W of Bermuda		July 18	8.00 P.M.	30	0	0
103	T2		32° 00'	160 m. W of Bermuda		July 19				
104		33° 58'	70° 21'	275 m. NW of Bermuda		July 20	1.48 P.M.	1	48	0
105	T1	34° 27'	71° 36'	210 m. ESE of Cape Hatteras		July 20	1.48 P.M.	1	48	250
	T2						1.48 P.M.	1	48	500
	T3						1.48 P.M.	1	48	600
	T4						1.48 P.M.	1	48	700
	T5						1.48 P.M.	1	48	1274
	T6						1.48 P.M.	1	48	1454
106		34° 44'	73° 20'	115 m. SE of Cape Hatteras		July 21	1.48 P.M.	1	52	0
107	T1	34° 47'	73° 41'	100 m. SE of Cape Hatteras		July 21	1.48 P.M.	1	52	250
	T2						1.48 P.M.	1	52	500
	T3						1.48 P.M.	1	52	600
	T4						1.48 P.M.	1	52	700
	T5						1.48 P.M.	1	52	1274
	T6						1.48 P.M.	1	52	1454

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Duration of Haul M	Depth in Fathoms	Depth in Metres
		Lat	Long West							
108	T1	36° 55'	74° 12'	90 m. E of Chesapeake Bay	1091	July 22	11.12 A.M.	1	49	0
	T2						11.12 A.M.	1	49	545
	T3						11.12 A.M.	1	49	727
	T4						11.12 A.M.	1	49	909
	T5						11.12 A.M.	1	49	1090
	T6						11.12 A.M.	1	49	1274
109	D1	36° 56'	75° 28'	30 m. E of Chesapeake Bay	1091	July 23	8.45 A.M.	20	19	36
	D2						8.45 A.M.	20	32	60
	T1	30° 16'	74° 58'							
110	T1	38° 00'	74° 02'	45 m. E of Chesapeake Bay	1091	July 23	8.00 P.M.	30	0	0
	PT1									
	D1									
111	D2			100 m. SE of Delaware Bay	950-1200	July 24	9.07 A.M.	20	60	109
	T1	38° 31'	73° 12'				11.46 A.M.	54	382	694
	T2									
112	T1	39° 15'	72° 00'	125 m. SE of City Hall, N. Y. City	950-1200	July 24	8.00 P.M.	30	0	0
	T2									
	T3									
113	T4			125 m. SE of City Hall, N. Y. City	950-1200	July 25	8.52 A.M.	31	633	1150
	T5						11.35 A.M.	1	27	545
	T6						11.35 A.M.	1	27	636
	T7						11.35 A.M.	1	27	727
	T8						11.35 A.M.	1	27	818
	T9						11.35 A.M.	1	27	909
	T10						10.00 P.M.	30	0	0
	T11						11.00 P.M.	30	0	0
	T12						12.00 A.M.	30	0	0
	T13						1.00 A.M.	30	0	0
114	T14						2.00 A.M.	30	0	0
	T15						3.00 A.M.	30	0	0
	T16						4.00 A.M.	30	0	0
	T17						5.00 A.M.	30	0	0
	T18						6.00 A.M.	30	0	0
	T19						7.00 A.M.	30	0	0
	T20						8.00 A.M.	30	0	0
	T21						9.00 A.M.	30	0	0
115	T22						10.00 A.M.	30	0	0
	T23						11.00 A.M.	30	0	0

Sation Number	Individual Haul	Position		General Locality	Date 1925	Time	Duration of Haul	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West			H	M		
T24	T25					4.00 P.M.	30	0	0
T26	T27					5.00 P.M.	30	0	0
T26	T27					6.00 P.M.	30	0	0
T27	T28					7.00 P.M.	30	0	0
T28	T29					6.00 P.M.	30	0	0
T29	VCI					7.00 P.M.	30	0	0
VCI	VC2					8.00 P.M.	30	0	0
VC2	V1					9.00 P.M.	30	0	0
V1	V2						437-273	800-500	
V2	V3						546-437	1000-800	
V3	V4						546-0	1000-0	
V4	V5						419-0	419-0	
V5	T30						164-0	300-0	
T30	T31						164-0	300-0	
T31	T32						54-0	100-0	
T32	T33								
T33	T34								
T34	T35								
T35	T36								
T36	T37								
T37	T38								
T38	T39								
T39	PT1								
PT1	T40								
T40	T41								
T41	T42								
T42	T43								
T43	T44								
T44	PT2								
PT2	T45								
T45	T46								
T46	D2								
D2	D3								
D3	P13								

July 29

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CHART OF CENTIGRADE TEMPERATURES OF PACIFIC STATIONS

Depths Metres	Sta. 50		Sta. 51		Sta. 56		Sta. 59		Sta. 66		Sta. 68		Sta. 74		Sta. 84		
	C.	C.T.															
0	0	25.9	-0.05	23.45	0	27.2	0	27.5	0	28.5	0	28	0	27.5	0	22.1	
0	0	—	—	—	0	—	0	—	0	—	0	—	0	—	0	—	
25	—	—	—	—	22.1	—	23.2	—	27.9	—	26.5	—	28.65	—	27.1	0	20.6
50	-0.05	22.45	0	—	21.47	-0.15	18.75	+0.05	22.55	-0.15	18.3	-0.1	23.67	-0.1	19.97	—	22.0
75	—	—	—	—	0.05	-0.1	—	+0.05	—	-0.15	—	-0.05	—	-0.15	—	—	
100	-0.15	15.45	-0.05	20.87	-0.1	16.25	-0.2	14.3	-0.2	13.97	-0.25	15.57	-0.25	14.57	-0.05	18.75	
150	-0.15	0	—	—	-0.15	—	-0.2	—	-0.2	—	-0.2	—	-0.2	—	-0.05	—	
250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
300	-0.2	11.6	-0.2	11.9	-0.2	12.22	-0.25	11.3	-0.2	11.27	-0.25	11.20	-0.2	11.62	-0.2	11.8	
450	-0.2	—	-0.2	—	-0.25	—	-0.25	—	-0.25	—	-0.3	—	-0.2	—	-0.2	—	
500	-0.25	8.32	-0.3	7.9	-0.25	8.25	-0.25	8.1	-0.25	7.92	-0.3	8.3	-0.25	8.35	-0.25	7.95	
1000	-0.4	—	-0.3	—	-0.25	—	-0.25	—	-0.25	—	-0.2	—	-0.25	—	-0.25	—	
1500	-0.5	—	4.8	—	—	—	—	—	—	—	—	—	—	—	—	—	
2000	-0.45	—	2.4	—	—	—	—	—	—	—	—	—	—	—	—	—	
2500	-0.45	—	1.95	—	—	—	—	—	—	—	—	—	—	—	—	—	
3000	-0.45	—	1.72	—	—	—	—	—	—	—	—	—	—	—	—	—	
	-0.5	—	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	

Note: C. = Correction.

C.T. = Corrected Temperature—or average of 2 corrected readings.

* 2 sets thermometers taken at this depth: 1 = first set, 2 = second set.

IV. CHLORINE IN SEA WATER 0/00.

BY TITRATION WITH SILVER NITRATE

MADE BY JOHN B. WILSON, ASSOC. CHEMIST.

Bureau of Chemistry, U. S. Department of Agriculture

Station No.	Surface	25M	50M	75M	100M	250M	300M	450M	500M	1000M	1500M	2000M	2500M	3000M
3.							19.36							
5.	20.46		19.48				20.11		19.92	19.57				
9.	20.46		20.52		20.64		20.70		20.26	19.74				
15.	20.46				20.60		20.26		19.97	19.46	19.28			
16.	20.35				20.16		20.05		19.51	19.26	19.40			
20.	20.00				19.37		19.22		19.22					
26.	18.92		19.45		19.37		19.31		19.21	19.17				
28.	18.70		19.21		19.38					19.23				
31.	18.75	18.74	18.74		18.89									
31B.	18.33				18.44	19.29	19.27	19.33						
33.					19.47	19.30	19.15	19.34						
35.	18.87	18.89	19.26		19.40	19.31								
38.	18.62	18.76	18.95			19.25	19.24							
39.	18.66	18.69	19.16		19.36		19.29	19.34						
40.	18.46	17.79	19.17	19.45			19.30	19.20						
50.	18.78	19.12	19.28	19.44	19.34		19.30							
51.	18.91	19.45	19.54	19.48	19.44		19.34	19.04						
56.	18.77	18.96	19.44	19.39	19.36		19.36	19.20						
59.	17.76	18.17	18.86	19.30	19.27		19.32	19.18						
66.	17.79	18.73	19.16	19.27	19.25		19.25	19.16						
68.	18.24	18.61	19.06	19.25	19.25		19.25	19.10						
74.	17.88	18.25	19.98	19.38	19.48		19.22	19.18						
84.	19.32	19.32	19.56	19.45	19.56		20.21	20.23	20.08	20.03	19.39			
96.	20.14						20.20	20.13	20.14	19.59	19.36			
98.	20.20													
99.	20.19													
101.	20.10													
103.	19.97													
104.	20.00													
105.														

Land-locked Lagoon, Tower Island April 17, '25 Surface Edge
 Land-locked Lagoon, Tower Island April 17, '25 Surface Center 22.14
 Green Water, near Volcano, Albemarie Island 25.40
 18.72

V. RÉSUMÉ OF STATION AND HAUL RESULTS

As introduction to this preliminary survey of the plankton hauls of the *Arcturus* Expedition it may be worth while to quote a few paragraphs from one of my recently published popular accounts.*

One dark, moonless evening I put out a silk surface net the mouth of which was round, and about a metre, or a yard, in diameter.

At the further end of the net a quart preserve jar was tied to receive and hold any small creatures which might be caught as the net was drawn slowly along the surface of the water. This was done at the speed of two knots, and, as I have said, was continued for the duration of one hour. When drawn in, the net sagged heavily and we poured out an overflowing mass of rich pink jelly into a white, shallow tray. This I weighed carefully, and then took, as exactly as possible, a one-hundred-and-fiftieth portion. I began to go over this, but soon became discouraged, and again divided it and set to work on one-sixth of the fraction on which I had first started. After many hours of eye-straining and counting under the microscope, I conservatively estimated my one-hundred-and-fiftieth part of the hour's plankton haul as follows:—

Feathery copepods—Candace-like	7,920
Bright blue copopods—Pontella-like	71,400
Other copopods—Calanus-like	139,320
Bivalve crustacea—Ostracods	4,920
Short-eyed shrimps	720
Siphonophores	14,400
Heliced snails	8,880
Purple Ianthina snails	13,440
Egg masses of snails	1,080
Free eggs, various	5,280
Clio-like pteropods	2,520
Limacina-like pteropods	240
Cavolinia-like pteropods	960
<hr/>	
Total of specimens	271,080

If we multiply this by one hundred and fifty we get forty million, six hundred and sixty-two thousand individuals. Please remember that this is a very conservative estimate of only a few of the more easily counted groups in one small haul of an hour's duration, and the magnitude of the life of the sea will begin to dawn

* *The Arcturus Adventure*, pp. 199–200.

upon our minds. Twelve hours later—in full daylight—I repeated the haul as closely as possible and, instead of forty million, I captured about one thousand individuals of the corresponding groups.

The above figures give a more vivid meaning to the terms of relative occurrence, such as Abundant, Common and Many, which I have used in the following data. At my suggestion Dr. C. J. Fish kept a relatively accurate tally of the more easily recognizable groups of invertebrates of the plankton hauls, while I made a corresponding catalogue of the fish. For this purpose there was no attempt at specific identification, but the mere listing, in relative abundance, of the hundred-odd groups which leaped to the eye out of the quarts of millions of living organisms.

Reference to the Station data given in preceding pages will furnish the details of each haul, which can then be correlated with the present scheme. Future papers will present the exact identification of the various components.

As regards the symbols of relative abundance and rarity, after considerable thought, I have altered the scheme which I use in ecological work in the jungle,* and have made a compromise with that of Dr. Fish. This is as follows:—

A—Exceedingly Abundant

C—Common; Abundant

M—Many

F—Few

R—Rare; Very Few

Applying this to the count made on page 27 I should adopt the following:

A—Calanus copepods	139,320
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C—Pontella copepods	71,400
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M—Siphonophores	14,400
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F—Limacina pteropods	240
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The sequence of groups under each haul is by relationship. In the case of unidentified species I have sometimes used arbitrary popular names which at least indicate the general group.

* *Zoologica*, VI, No. 1, p. 43.

VI. PACIFIC DEPTH PLANKTON HAULS

As closing nets were not used, there is, in the following tables, a small percentage of error, from the organisms, however few in number, which entered the nets during their comparatively rapid ascent to the surface. Rather than attempt to orient these I have chosen to include the sporadic occurrence of such obviously out-of-place organisms as *Halobates* at 300 and 600 fathoms and *Glaucus*, *Ianthina* and *Pontella* at 600 and 800 fathoms.

20—Fathom Plankton

Station and Haul	26 OT1
Siphonophores (transparent)	M
Jellyfish (transparent)	F
<i>Sagitta</i> (large)	A
<i>Firola</i>	M
Copepods	R
<i>Eucalanus</i>	R
Amphipods	M
Hyperid Amphipods	M
Lucifer	M
Macruran larvae	M
<i>Bachyura megalops</i>	1
<i>Squilla</i> larvae	C

50—Fathom Plankton

	48 T2
<i>Hydromedusae</i>	M
<i>Sagitta</i> (small)	C
<i>Tomopteris</i>	1
<i>Creseis acicula</i>	C
<i>Cresia conica</i>	C
<i>Cavilina uncinata</i>	2
Copepods (small pink)	C
<i>Eucalanus</i>	F
Hyperids (yellow)	F
Euphausids (young)	F
<i>Porcellana</i> larvae	1
<i>Halobates</i>	1

100—Fathom Plankton

	59 T2	86 PT1	87 T1
Heliozoans (red)	M		
Radiolarians			M
Liriope			1
Tomopteris	1		
Gastropods	F		
Atlanta	2	1	
Cymbulia sibogae	1		
Copepods (small pink)	F		
Caligus (brown)			F
Hyperids (yellow)			1
Gnathophausia willemoesia		F	
Euphausiids	F		
Macrurans (red)		R	

150—Fathom Plankton

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Siphonophores	M		M				C
Pleurobrachia (small)							F
Beroe (pink)							F
Annelids	1						R
Tomopteris	R						
Sagitta	C		F		F	R	F
Clio	C						
Firola	F			R		F	F
Hyaloclylix striata		F	C		M	M	M
Creseis		R	C				R
Cavolina longirostris			M				
Atlanta				R			
Clionopsis grandis				R			
Diacra quadridentata						R	R
Limacina inflata							A
Cymbulia sibogae					A		

150—Fathom Plankton (*Continued*)

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Glaucus			2				
Ostracods (small white)						C	F
Ostracods (orange)	F				F	F	F
Copopods (small pink)				C	F	M	
Eucalanus elongatus	A			M			R
Pontella			C		R		
Sapphirina	F		R				F
Mysids			R		R		
Candace					R		
Hyperids	M		A				
Phronima					M	M	M
Oxycephalids							R
Gammarids (orange)							F
Other Amphipods	R	R	A	F	F		
Euphausids		C				A	R
Brachyura megalops		1					
Nauplius		1					
Phyllosoma			3				
Squilla larvae	F						
Salpa			C				R

200—Fathom Plankton

	49 PT1
Sagitta (large, transparent)	R
Limacina inflata	C
Limacina lesueuri	C
Creseis acicula	M
Creseis conica	M
Copepods (Small pink)	M
Pontella	M
Mysids	R
Euphausids (small, white)	C
Euphausids (pale pink)	1
Megalops	A
Phyllosoma	Z
Squilla larvae	C

	300-Fathom Plankton															
	26 P _{T1}	28 P _{T1}	51 T ₃	51 P _{T1}	59 T ₃	59 P _{T1}	61 T ₃	66 T ₁	68 T ₂	74 T ₃	74 T ₁₄	74 T ₁₈	84 T ₁	84 T ₇	84 T ₁₁	
Medusae (transparent)							R									
Beroe (small)								R					R			
Pleurobrachia								R								
Atolla												R				
Diphyes									R				R			
Siphonophores							C					R	R			
Pelagothuria												R				
Annelids (brown)								R					R			
Annelids (pink)								M	R				F			
Sagitta (large white)				C				M	R				F			
Sagitta (pink)						R		R	R				F			
Firola		M	F					R	R				R			
Clio		M										R				
Diacra quadridentata					R	R					R					
Diacra trispinosa					R											
Cavolina uncinata					R							R				
Clionopsis grandis					R											
Cymbulia silogae					R		F				R					
Orescis acicula											R					
Hyaloclylix											R		R			
Atlanta											R ₁					
Glaucus										R		C	R			
Ostracods (orange)										R		R				
Copepods (small pink)							A			R		R	F			

	300—Fathom Plankton (Continued)														
	26 PT1	28 PT1	51 T3	51 PT1	59 T3	59 T8	61 T3	66 T1	68 T2	74 T3	74 T14	84 T18	84 T1	84 T7	84 T11
Copepods (large red)	F														
Eucalanus															
Pontella															
Lucifer															
Gnathophanisia (small red)						R									
Phronima					R	F	R								
Amphipods (orange)						F	F		R						
Hyperids						R									
Oxycephalids															
Gammarids (orange)									R						
Amphipods (transparent)															
Amphipods (pale slate)								M							
Euphausiids (pink patches)					R			C							
Euphausiids (small white)							M								
Other Schizopods	C														
Macrurids (red and white)															
Megalops (red)															
Shrimps (scarlet)	M							F							
Shrimps (orange)	F														
Salpae	M									R					
Doliolum	A							M							
Pyrosoma								R							
Halobates												R ¹			
													R ⁸		

400—Fathom Plankton

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Ctenophores (orange)		R		F			
Beroe (pink)				R			
Atolla				R			
Actinarians (orange)				F			
Siphonophores	R						
Porpita	R ²		R ¹				
Pelagothuria						R	R
Annelids (large white)				R			
Sagitta (large white)	R						F
Eukrohnia (pink)	F	Ni		R	R	F	F
Firola			R				
Cymbulia		R			R		F
Clio pyramidata	F				F	R	
Clionopsis krohni					R		
Limacina	F						
Hyaloclylix	F						
Creseis conica	F						
Creseis acicula	R						
Atlanta	R						
Limacina	R						
Cavolina	R						
Diacra trispinosa	R						
Cymbulopsis	F						
Glaucus	R ³		R ²				
Ianthina	R ¹						
Squids			R				
Ostracods	F		F				
Copepods (large red)	F			M	F	F	M
Eucalanus	A		A		M	C	F
Pontella	R						
Gnathophausia willemoesia			R			F	R
Isopods (black)						R	R
Hyperids	F	F					
Phronima	F			R			
Gammarids (pink)						M	
Oxycephalids			R	M		F	R
Other Amphipods (white)	M						

400—Fathom Plankton (*Continued*)

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Amphipods (orange)					R	R	
Euphausids (adults)	M	M	M	F	M	C	M
Macrurids (red)		F			F		F
Lucifer	M						
Eryoneicus						R	
Squilla (larvae)	R						
Salpa				R			

450—Fathom Plankton

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Actinians (orange)					R		
Periphylla					R		
Hydromedusae (white)	R						
Hydromedusae (yellow)			R				
Siphonophores		R		R			
Ctenophores		R					
Beroe				R			R
Annelids (orange)		R			M		
Eukrohnia (orange)	F		F		R		
Clio balantium	R						
Cymbulia	R						
Diacra quadridentata		R					
Peraclis			R				
Firola				F	R		
Ostracods (red)	F		R	R			
Copepods (red zone)	M	F		C		C	
Eucalanus		A	M				A
Mysids (red)	R						
Gnathophausia (small red)			R	F	F	F	
Hyperids (small pink)		R					
Gammarids (orange)					R		
Phronima	R	R	R				
Oxycephalids	R	R		R	R		
Amphipods (large red)	F	R	F				R
Euphausids (red)	R	F	F				
Euphausids (small white)		A					
Europa (deep red)							R
Macrurids (red and white)					F	F	

450—Fathom Plankton (*Continued*)

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Megalops (pink)				F			
Lucifer				F			
Shrimps (small red)			R				
Benthophausia (orange)					F		
Squilla (larvae)				R		R	
Isopods (brown)	R		R	F			

500—Fathom Plankton

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Medusae (small white)	M												.
Pleurobrachia (pink)	C	F		R									
Beroe (pink)		R			R			R	F	R			
Periphylla		R											
Atolla					F	R							
Actinians (larval scarlet)										M			
Annelids (yellow)										F			
Annelids (orange)	F												
Sagitta (salmon)	M	M	M	M	F	F	F	R				F	R
Sagitta (transparent)	R		F										
Planarians (orange)		R											
Nemertians													R
Firola	R		F	F	R			R		R	R		R
Peraclis													
Creseis conica					R								.
Creseis acicula					R								
Atlanta					R								
Clio pyramidata					R							F	
Clio balantium				R									
Hyaloclylix					R								
Peracles				F			F						
Clionopsis krohni								R					
Cymbulia													R
Octopus (fragile red)				R									
Ostracods (orange)	F		F		M					R			
Gigantocypris (small)													R G
Copepods (pink, red)	M	R	F	M	F	M	F	F				C	F
Eucalanus	M			C	C		C			C		M	C

500—Fathom Plankton (*Continued*)

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Calanids (small)	C												
Mysids (orange, red)			R		M							R	
Gnathophausia					R				C		C	C	
Isopods (black)		R			F	F			R	F			R F
Phronima		R		R				R					
Gammarids (orange, pink)		R		F		F				R			M
Gammarids (slate color)		R											
Oxycephalids						R	R						M
Euphausids (white)	C	M						F					C
Euphausids (pink patches)	F				F	M							
Schizopods (scarlet)									M				
Porcellana (larvae)									R				
Macrura (red and white)									C		C	F	R
Macrura (large, snow white)										F			
Eryoneicus									R				
Magalops (black, red)			R									R	R
Shrimps (small red)	R		F	F	R					R			
Shrimps (large red)	F		F		F								
Squilla (post larval)										R			
Salpa (small blue)													A
Salpa zonaria			R										
Doliolum	F												

550—Fathom Plankton

	74 T20
Atolla	F
Eukrohnia (red)	F
Diacra quadridentata	R
Eucalanus	A
Gnathophausia (small)	R
Mysids (red larvae)	R
Isopod (black)	R
Oxycephalids	R
Amphipods (fragile pink)	R
Euphausia (pink and white)	M
Benthophausia	F
Shrimp (small red)	R

600-Fathom Plankton (*Continued*)

							R ¹
Glaucus							
Diacra quadridentata				R			
Squid		R		R			
Octopus (large fragile)			R				
Ostracods (orange)		R	F		M	R	R
Copepods (bathypelagic)			F			R	M
Copepods (large red)	F		R	M	M		
Copepods (intermediate zone)	M	F		C	R	F	
Encalanus				M	M		
Cypris (larvae)				C	C	A	C
Myctids				F		A	M
Gnathophausia (dark red)					R	F	
Gnathophausia willemoesia			F			R	F
Isopods (black)	R	R			F		
Gammarids (pink)	F	R	F		R	R	
Amphipods (slate color)	R		R		R	R	
Phronima (transparent)	F			F	R	R	
Phronima (purple)					R	R	R
Oxycephalids						F	
Euphausiids (small white)	R	R	F	F	C		F
Euphausiids (red)		F		M	R	F	F
Hippa (larvae)					R		R
Sergestes (orange)							R

600—Fathom Plankton (Continued)														
	T ₅	P _{T1}	T ₁₀	P _{T2}	T ₅	P _{T1}	T ₅	P _{T1}	T ₅	P _{T1}	T ₉	P _{T1}	T ₉	
Phylosomes						R								
Macrurans (red)					R							R		F
Benthophausia (red)												F		R
Shrimps (large red)	R	M	M		M	C	F	C	F	R	R	R	R	
Squilla (larvae)			R		R		C							
Doliolum					F			F						
Appendicularia					F									
Salpa zonaria (purple)														
Halobates		R ¹				R ¹				R	R	R		

700—Fathom Plankton

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Actinians (larvae)		R			
Siphonophores					
Eucopa (deep wine color)				R	
Atolla wyvilli	R				
Halicreas papillosum	F				
Homoconema typicum	R				
Aequorea globosa	R				
Siphonophore	R			M	
Annelids (yellow)		R			
Sagitta (transparent)	M				
Sagitta (salmon)	C	F		M	
Nemerteans		R			
Firola	R		R	R	R
Atlanta	R	R	R		
Cavolina tridentata				R	
Cavolina uncinata			R		
Clio pyramidata	R	F	C		
Clio cuspidata				R	R
Cymbulia		F	F		
Squid (red)		R		R	
Ostracods (pink)	R				
Gigantocypris agassizi			R		
Copepods (large pink)	M			F	
Eucalanus		M		M	
Gnathophausia			F		
Gnathophausia brevispinis				R	F
Mysis		R			
Amphipods (pink)	F				
Hyperids	R				
Oxycephalids			R		
Gammaerids (pink)				F	
Macrurus (red and white)			M		R
Megalops (large)	R				
Porcellana (zoea)	R				
Zoea (long-spined)	R				
Benthophausia		R			
Shrimp (red)					R

700—Fathom Plankton (*Continued*)

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Squilla (larvae)	R	R	R		
Salpa cylindrica	R				
Euphausids		M	M	F	M

800—Fathom Plankton

	50 T3	50 OT1	53 T2	56 PT1	86 T4
Ctenophores					R
Annelids (pink)	R				
Sagitta (large transparent)	R		M	R	
Sagitta (pink)	F		R	R	F
Creseis conica	M		M		
Creseis acicula	F				
Clio pyramidata	F		R		
Clio balantium			R		
Hyalocylis	R		R		
Firola			R		F
Cymbulia					R
Ianthina		R ¹			
Squid					R
Ostracods (small orange)			R		
Gigantocypris			R		
Copepods (red)	M		M		M
Eucalanus	A				
Pontella	F				
Gnathophausia (red)			R	F	F
Isopod (black)	R			R	
Hyperids (white)	M				
Hyperids (red)				R	
Oxycephalids					R
Gammarids (orange)					M
Euphausids (red)			M	F	M
Schizopods (pink)	M				
Macrurans (red)			R	R	R
Benthophausia (orange)			R		
Shrimp (red)	R	R			F
Squilla (larvae pink)		R			
Salpae	F				

1000, 1100, and 1200—Fathom Plankton

	1000 fathoms 86 T5	1100 fathoms 53 T1	1200 fathoms 50 T4
Beroe (small pink)			R
Atolla	F		
Pelagothuria	F		
Sagitta (large transparent)		F	M
Sagitta (pink)	F	F	
Firola	R		
Atlanta		R	
Cavolina longirostris		R	
Creseis conica		R	
Creseis acicula		R	
Notabranchia		R	
Hyaloclylix striata		R	
Clio pyramidata			A
Eucalanus	C	A	
Gnathophausia (large red)	F		R
Isopods (black)	R		
Amphipods (pink fragile)			F
Gammarids (pink)	C		
Gammarids (orange)	F		
Oxycephalids	M		
Euphausid (pink)			R
Euphausids (white)	C	F	F
Porcellana (large)			R
Benthophausia (red)	F	F	
Shrimps (large red)		M	F
Squilla (post larva)			R
Ostracods (scarlet)	R		

VII. RELATIVE ABUNDANCE OF FIFTY-SEVEN GROUPS OF INVERTEBRATES IN
PACIFIC SURFACE HAULS

	Number of Occurrences in 47 Hauls	Abundant	Common	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Siphonophores	14	2	2	2	3	5	58
Porpita	13		1	2	8	2	43
Hydromedusae*	6	1		1	3	1	25
Ctenophores	8	1		1	5	1	31
Liriope	5		2		2	1	21
Stomatoca derissa	3			1	2		11
Mnemosyne	1	1					10
Pleurobrachia	1		1				7
Physalia	1					1	1
Sagitta	31	7	8	7	7	2	184
Annelids	3				2	1	7
Creseis conica	17		5	2	8	2	71
Creseis acicula	12		5	3	3	1	60
Atlanta	9	1		3	1	4	32
Glaucus	12			2	6	4	32
Ianthina	11			2	5	4	29
Diacra quadridentata	7	1		1	2	3	24
Firola	7		1	2	1	3	23
Gastropod larvae	2	2					20
Limacina	4	1	1			2	19
Hyaloclylix striata	5			1	4		17
Squid	8			2		6	16
Clio	5			1		4	9
Cavolina uncinata	5				1	4	7
Cavolina longirostris	2				1	1	4
Cymbulia	2					2	2
Peracles	1					1	1
Pneumoderma boasi	1					1	1
Euphausids	30	6	9	4	11		176
Pontella	30	2	6	11			117
Copepods, small	13	7	4	1	1		106

Relative Abundance of Fifty-seven groups (*Continued*)

	Number of Occurrences in 47 Hauls	Abundant	Common	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Megalops	19	3	1	4	8	3	84
Phyllosomas	18	2	3	3	5	5	76
Hyperids	17	1	3	3	7	3	70
Squilla larvae	15	1	2	2	5	5	54
Lucifer	12	1	1	4	5	1	53
Zoea	10	2	1	1	2	4	42
Amphipods	8	1		2	5		35
Eucalanus	10	1		2	4	3	35
Mysids	6	1	2		3		33
Calanus	3	3					30
Monops	7		2		4	1	27
Schizopods	3	1	1		1		20
Sapphirina	3		1	1	1		15
Macrurus larvae	3		1	1	1		15
Candace	3		1		1	1	11
Acartia	1	1					10
Ostracods	1		1				9
Isopods	4				1	3	6
Gammarids	1				1		3
Hippa larvae	3					3	3
Sergestes larvae	2					2	2
Phronima	1					1	1
Halobates	27			5	21	1	89
Salpae	13	3	5		4	1	78
Doliolum	1				1		3
Pyrosoma	1					1	1

VIII. RELATIVE ABUNDANCE OF SIX MAJOR GROUPS OF INVERTEBRATES IN FORTY-SEVEN SURFACE HAULS IN THE PACIFIC

Crustacea	1033	52.4 per cent
Mollusca	367	18.7 per cent
Coelenterata	207	10.5 per cent
Annelida	191	9.7 per cent
Insecta	89	4.5 per cent
Urochorda	82	4.2 per cent

